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DSTL, AVIA 6/17609, 9 Dec 2008

TECH. MEMO.
DIR. 15

ROYAL AIRCRAFT ESTABLISHMENT

(FARNBOROUGH)

TECHNICAL MEMORANDUM No: DIR. 15

FORMATION OF CHEMISTRY, PHYSICS AND METALLURGY DEPARTMENT

by

Director, R.A.E.

NOVEMBER, 1962

MINISTRY OF AVIATION, LONDON, W.C.2

Technical Memorandum No. Dir.15

November, 1962

R O Y A L A I R C R A F T E S T A B L I S H M E N T

(FARNBOROUGH)

FORMATION OF CHEMISTRY, PHYSICS AND METALLURGY DEPARTMENT

by

Director, R.A.E.

SUMMARY

This is a transcript of a recording of the Director's speech of 1st November, in the Assembly Hall, to which all members of Metallurgy and Physics Department and of Chemistry Department were invited, and in which he explained the background to the formation, as from 19th November 1962, of Chemistry, Physics and Metallurgy Department.

Ladies and Gentlemen,

It is very pleasant to see so many familiar faces, in fact almost the whole of the Chemistry Department and the Metallurgy & Physics Department, in front of me in this Hall. They are two Departments that I always particularly enjoy going round, asking all the questions, relevant and irrelevant, that occur to me on such occasions. Indeed, I think that any Director of the R.A.E. must feel particularly proud of the high quality of the two Departments that are represented here this afternoon. What I mean is that, to a place like the Royal Aircraft Establishment, you would expect to attract good teams in aerodynamics, rocketry, automatic control, and so on. It is especially satisfactory, however, that the R.A.E. has been able in addition to gather such fine teams of chemists, metallurgists and physicists. The whole Establishment is proud of these teams, and recognizes that they are doing high-grade scientific work, well related to practical requirements, and, at the same time, performing substantial, valuable service functions for the R.A.E. as a whole, in the respective disciplines of chemistry, physics and metallurgy.

I have a deep conviction of the vital importance of what I call 'applied high-grade science', and that is what we see in Metallurgy and Physics, and in Chemistry Department. By 'applied high-grade science' I mean what one associates, perhaps, with the Bell Telephone Laboratories in the U.S.A. The industrial laboratories in the United Kingdom have often fallen a little short in this respect. Very often the long term forward look has seemed to be lacking. Possibly they tend to keep too tight a rein on the research; they are always stopping it in some area at the slightest hint of a change in the future look on projects. This kind of stop-go policy is the worst possible thing for research, and we are determined not to have it in these two R.A.E. Departments represented here.

The Universities in this country are perhaps also to blame in some respects. They do set, very often, extremely high standards in the scientific research done, but I think that often they are too inclined to disregard applicability altogether. The Prime Minister, in his pamphlet on the Common Market, drew attention to a point which we have all got to take seriously. He wrote: "For many years in the past, Britain was assured of a clear lead as an industrial power, but now many other nations have caught up with us in the more orthodox and established types of product. This means that we must, in future, make a great effort as pioneers and leaders of the new, revolutionary processes such as electronics, automatic equipment, computers, miniaturisation and supersonic flight". There are a lot of others that he could obviously have added here, many in the materials field, but the essential point is that our economic future depends on our importing raw materials, and then exporting finished products which cost a great deal more than the raw materials, because they have been subjected to really advanced technological processes. Therefore, it is from the advanced technologies that this country can most benefit.

I think it is unfortunate that academic research has, to some extent, failed to take this into account. Sometimes it has taken the view that nothing matters except the production of high-grade scientific work. However, if you apply this extra boundary condition, that one has selected the work to be done because of its potential for advanced technological application, or allowed the progress of the research to be guided by the possibilities that one can see, and if under this extra boundary condition you still manage to do high-grade scientific work, you have evidently acquired even greater merit.

I am glad to say that this is just what has been achieved in Metallurgy & Physics Department and in Chemistry Department. Certainly, while I have been here, I have noticed many cases of it. I am inclined,

therefore, to think that these Departments of R.A.E. make up a complex of particular value to the country as a whole, and that they stand in a position which is in some ways superior both to the academic researchers and to the industrial researchers. We work in R.A.E. in an atmosphere where applications are always being brought to our notice. There are requirements in the aircraft and rocket industry in particular, and a number of other industries also are constantly in touch with us. Their problems are forced to our attention. We work in an atmosphere where we cannot disregard them, do not wish to disregard them, and allow our research work to be strongly influenced by them. At the same time, the Heads of the Departments concerned have always set their face against allowing research to be held with this very tight rein I spoke of earlier. Equally in the future we are determined to avoid a stop-go policy influenced too closely by the variations in specific project requirements. Rather we want, as at present, a constant watch kept on the broad needs throughout the application field, and we want the work as it progresses to be consciously guided towards the possibilities of advanced technological applications (rather than being constantly chopped about or cut to ribbons so that no results of value come forth at all).

I would like to give, perhaps, a brief run through some examples of what I mean when I describe the work in these Departments as being 'applied high-grade science'. I will just be picking out a few examples; it is impossible for me to mention everything.

The team led by Mr. Forsyth and Mr. Ryder, on fatigue, fracture and stress corrosion, has constantly achieved a very remarkable standard of work on the fundamental mechanisms of fatigue and fracture - for example, elucidating the two stages of crack propagation, or relating striations on the surface to individual stress cycles - and, at the same time, has shown an admirable interest in the practical applications, such as, recently, the development of a variety of types of composite material which will be more resistant to crack propagation (and the Sherlock Holmes side when Mr. Forsyth performs his function as an accident investigator and declares that the thing is obviously a case of stress corrosion or whatever it may be).

Another good example is the work of Mr. Brooks and Mr. Brown in the field of alloy development, particularly their successful work on titanium. They have developed a range of new titanium alloys with various properties which give them advantages over alloys previously available, particularly in respect of stiffness. From a more fundamental point of view, their work on explaining the anomalous embrittlement of titanium, above something like 8% aluminium, was of startling originality, showing the need, in fact, for a complete revision of the titanium-aluminium phase diagram. I am very interested also in the work now being done on ultra high tensile steels, the object being to find ways of avoiding the corrosion problem with these steels without allowing embrittlement by hydrogen in the neighbourhood of the surface. There are a lot of interesting electro-chemical problems involved here in finding platings or coatings that will be effective in avoiding corrosion and yet allow us to get rid of the hydrogen.

The physical team, under Mr. Bradshaw and Mr. Wadsworth, have produced really valuable results on the effect of different atmospheric environments on fatigue life and, more recently, on the physics of work hardening. Important studies have also been begun recently using ultra-high-vacuum gear, including Mr. Bradshaw's work in the surface diffusion field and a very major investigation of Mr. Carpenter himself with Mr. Mair, Mr. Pearson, Mr. Gilbey and others on accommodation co-efficients, which we think is highly relevant to our present Space interests. This involved the development of a new device, the microbalance, which may have a range of applications quite outside the investigation which gave rise to it. There is also important work being planned on friction and lubrication of solid surfaces under these ultra-high-vacuum conditions.

The work on very-high-temperature materials, by Mr. Watt and Mr. Bickerdike, is exceptionally well known, and the results of Mr. Watt's work in the application to graphite rocket nozzles are now beginning to come to fruition. Beyond that, he is making important investigations into the practical utilisation of the refractory metals. The recent developments in the use of carbon, with which Mr. Bickerdike has been associated, are especially promising, notably the work using powder-casting (with subsequent deposition from a vapour phase) to produce very accurately shaped models in carbon without machining, and the range of developments, for application to the high-temperature gas-cooled reactor, the important Dragon project, in which fuel is sealed in very small pellets by means of impermeable graphite and fluidised beds are used as a practical process for vapour deposition on these particles.

We value, particularly in connection with the supersonic transport project, the work of Mr. Ballett and his testing team. It is absolutely essential that the Metallurgical Division continues to have proper test facilities, and the large contribution that Mr. Ballett has been able to make to the co-operative programme on the supersonic transport materials is a good example of their value. I believe that his tests are well on into their second ten-thousand hours.

There are very important analytical groups in both Metallurgy & Physics Department and Chemistry Department, Mr. Davis's on metallurgical analysis, and Mr. Clark's and Mr. Eastabrook's on electron-microscope work, X-ray crystallography, and the like. Mr. Fennell's service to the Royal Aircraft Establishment throughout the field of chemical analysis is particularly valued, and he is himself a well-known authority in the field of sub-micro-analysis. Chemistry Department is tending more and more to adopt all the modern techniques in the field of chemical analysis, including the more physical techniques such as the use of the mass-spectrometer, infra-red, and so on.

One of the best known groups in Chemistry Department is that led by Mr. Russell and Dr. Wright, which in an important sense is the centre of the work in this country on the development of polymers. I call it the centre because almost all the groups in the country that are attempting to develop new polymers have them in the end evaluated there, and the section is regarded as second to none in the country in its capability of evaluating the thermal, oxidative, and hydrolytic stability of polymers.

Recently, of course, R.A.E. has taken the lead to an equal extent on the synthetic side. I am very happy to see such a large body of synthetic work growing up, both polymer synthesis and allied work on high-temperature synthesis of other types of material, liquids and so on. We have on the one hand Mr. Fear's much enlarged section where a number of very promising lines have been pursued, the phosphorus-silicon organic compounds, fluoroaromatic groups in polymers and polymers involving hetrocyclic rings. At the same time, an exciting body of work, under Mr. Phillips, has started up with the main application at present to the resin-impregnated cloths and felts of various kinds (e.g. asbestos), using essentially resins based on aromatic compounds, and already great improvements in actual practically usable bits of material have been found, improvements in respect of resistance to high temperatures.

I mentioned the fact that there is a large body of work going on all over the country, sponsored by the Ministry of Aviation, in this field of synthesis of high-temperature materials. I am sure that it is the job of R.A.E. to act as the centre of this work in all respects, in fact not only in the evaluative aspect which I mentioned before, but also from the point of view of leading this work and acting as a focus for it. I am very glad of the new arrangements which we are making in co-operation with

the Director of Materials to see that the supervision of this work is done as much as possible by scientists from Chemistry Department. I think we have everything to gain by working closely in with the good teams in this field, and, if some of the teams are not good, well, perhaps, we can help a bit by pointing it out in the right quarters.

The new rubber laboratory is a very satisfactory development. Already improvements have been made to one of the best known synthetic rubbers, the Viton A, by use again of an aromatic compound as a cross-linking agent, and, bearing in mind the large scale of the industrial complexes in this field, it is most satisfactory to see that Chemistry Department has been able to get right into this subject and start making useful contributions at so early a stage.

For a long time, of course, we have been rather proud of the contributions of Chemistry Department to engineering in plastics, sometimes on quite a large scale, and the concomitant work in the rain erosion field. Similarly, we regard the lubrication field as an important one; solid lubricants are bound to be of growing importance as we go into more and more high-temperature situations, with supersonic aircraft, and possibly space vehicles, and Mr. Kinner's team on solid lubricants has done a lot to make the mechanism of lubrication somewhat clearer, and in particular to eliminate some suggestions that had been put forward very seriously in the past. The Electro-Chemistry Section under Mr. Doran, and the general guidance of Mr. Earwicker, is of great importance, and is doing a lot for batteries which will be suitable for missiles and satellites, particularly from the point of view of improving understanding of the electrode processes in alkaline batteries. To mention at last one more group, just started up, which I think we all wish well, the Combustion Group, we recognize that this is Dr. Mullins's own subject, and no doubt we had to assume, if we brought in Dr. Mullins, that sooner or later combustion would start being done in the R.A.E. again. This is now beginning to get going under Dr. Miller, and indeed we recognize that we must get into a position with supersonic aircraft to evaluate hazards such as the spontaneous ignition hazard.

Well, I have mentioned a few examples of what I mean when I say that these two Departments are doing 'applied high-grade science'. If I was asked to follow this up with some constructive criticism, I think the most I could do would be to point out the danger of splitting into a large number of ultra-specialised little knots. There is always the danger that, because any of these fields that I have mentioned is really such an enormous field, in which one might easily take a lifetime to become an expert, one may despair of ever taking an interest in the other fields. It would, however, be most unfortunate if these two Departments were to break up into such ultra-specialised knots, which did not interact much upon one another. A scientist can always benefit by consciously forcing himself to broaden his interest, particularly by trying to understand the work of his colleagues. I think the Heads of the Departments have both done a lot of valuable work in this way, trying to make sure that each of the groups becomes fully aware of the work of the others, and of the major problems involved, and consciously tries to understand the problems that the other people are facing, and become able to talk about them. Such conscious self-broadening helps, sooner or later, in one's own research work, because there are always unexpected analogies between Mr. A's problem and Mr. B's. In the main, however, the individual must evolve his own interests; the discontinuous approach, in which someone keeps poring over Organisation Charts and saying 'it's time that so and so was posted to here' is very wasteful. One has got, rather, to encourage people to evolve on their own, constantly broadening their interests and changing their line of attack on problems, and, sometimes, changing their whole line of research, but at the right moment and not at some arbitrarily chosen one.

Well, everything I have said so far must have made it clear how satisfactory I find the state of affairs. I have emphasised this, and it is a

completely sincere opinion. It follows, almost, that this is a situation so satisfactory that there is manifestly no need for any intervention by the Director, except, as I said, in respect of wandering round making remarks that may, in most cases, be completely irrelevant but of which I always feel that there is a finite probability that they might have some value.

However, one small ripple in the pond arose, quite a little time ago now, which was this. Mr. Carpenter who, I think, more than anyone else, is responsible for the very good health of Metallurgy & Physics Department that I have mentioned, was given Individual Merit Promotion to D.C.S.O., on the basis of his distinguished work as a research physicist, and his work in, to a large extent, selecting, training and encouraging the very fine team that there is in Metallurgy & Physics Department. Furthermore, the panel that recommended his promotion added a rider to the recommendation, suggesting that Mr. Carpenter ' should be relieved of some of his non-scientific work, in order that he may have more time for his own researches'. I have already mentioned, of course, how we value the particular researches in which Mr. Carpenter has been recently engaged, and naturally we wished, as far as possible, to take action on this recommendation, though it was not a very easy matter for us.

This was already some time ago, as I have said, and another point has since arisen, or has arisen by now, namely, that it is only a matter of months before he reaches the specific birthday beyond which it is not normal policy to retain Heads of Departments in this Establishment. These two points together, then, made it necessary to consider the problem of a successor. Now, certainly, there is no lack of brilliant scientists in Metallurgy & Physics Department but, as is well known, many of them are what you might call brilliant individualists, brilliant independent research workers; for example, there are four Individual Merit S.P.S.O's in Metallurgy & Physics Department. Partly for this reason, I found it extremely difficult to select a suitable new Head from within Metallurgy & Physics Department, and equally difficult to attract somebody from outside who would be good enough to put over all the very fine scientists that there are in the Department; especially difficult, in fact, at the grade of S.P.S.O., which was all that we had available.

Well, these two problems, as they gradually became more acute, made Mr. Handel Davies and myself think over a great variety of possible ways of dealing with them; and one of them, which sooner or later we thought it desirable to consider, and which looked more attractive the more we considered it, was the proposal which has been made several times in the past of a single Head for the two Departments, Metallurgy & Physics on the one hand and Chemistry on the other, a single Head, that is to say, who could be a D.C.S.O. At that level, we felt it would become very much easier to find somebody good enough, even to do the very difficult job of supplying scientific leadership in these three very important fields.

Now admittedly, you might say that this has been tried before. During the war, as we know, there was a Materials Department, and I get the impression that there were no lamentations when, at the end of the war, the two bits of that Department were separated. The two bits, were, of course, in those days very different from the two present Departments which I have just described at such length. This is an important difference. A less important one is that Materials Department was rather a depressing name. I don't know why this should be so. We must all admit that the sciences of materials are extremely important, and they obviously have a very great future, but nevertheless a chemist likes to recognise himself as a chemist, a physicist as a physicist and a metallurgist as a metallurgist. Accordingly, we did not take very seriously the concept of a Materials Department, but we did begin to flirt with the possibility of a Chemistry, Physics & Metallurgy Department.

We felt, also to some extent, that, although it might have been difficult in the war to combine chemistry with metallurgy, and there are even rumours that the metallurgists and the physicists have not always lain down together like the lion and the lamb, nevertheless the concept of a sort of triatomic molecule, with chemistry and physics and metallurgy all together, might be more stable (something to do with the angles of the bonds, no doubt!); it might work more effectively, perhaps because physics would be the cementing link; or, indeed, since there are four divisions, Non-Metallic Materials, General Chemistry, Physics and High-temperature Materials, and Metallurgy, it may be that both the second and the third can act as links (themselves bound together by common interests) between the first and the fourth; a sort of amphoteric arrangement.

As a result of these considerations, we abandoned any suggestion that a combined Department should be referred to simply as a Materials Department, even though we recognised that the application to advanced materials would be very important. Since, furthermore, those concerned would always perform important general services in the fields of chemistry and physics to other Departments in the R.A.E., we thought it essential to choose a name that would make clear that we have a centre of chemistry in the Establishment, and a centre of physics. The use of a name like Chemistry, Physics and Metallurgy Department would emphasize that this is a Department where we want chemists to do good chemistry, physicists good physics, and metallurgists good metallurgy, in each case constantly guided by practical requirements.

Of course, we feel that the common interests between the two Departments are much greater now than they were all those years ago during the war. This may have seemed fairly obvious during the brief catalogue that I was giving earlier on. We have, for example, the analytical groups which have a lot in common in their chemistry, their physics and their metallurgy. There are common interests on the electro-chemical side between the people who have to worry about corrosion and the people who have to worry about batteries. There are common interests in the field of lubrication, particularly high-vacuum lubrication. On non-metallic materials I have to go a bit warily, because it has always been understood that things like ceramics are as it were 'honorary metals', and so one can't suggest that, because graphite and silicon nitride and things are done in Metallurgy and Physics Department, they therefore have a link with the chemists. However, I think one must bear in mind that in the future development of ceramics chemical considerations may play a much bigger part than they have in the past, particularly if we are going to tackle the real 64-dollar question of how to get some ductility into them.

Well, gradually, the concept grew up that we might be able to meet the request from the Interdepartmental Scientific Panel with regard to Mr. Carpenter's so-called non-scientific work, if we were to think in terms of these four divisions, with three S.P.S.O's, Mr. Brooks, Mr. Russell and Mr. Earwicker, in charge of those on Metallurgy, Non-Metallic Materials and General Chemistry respectively, provided that Mr. Carpenter's position as Head of the present Department were annulled but he were to retain his position as Head of the Physics and High-Temperature Materials Division as an Individual Merit D.C.S.O. At the same time a new D.C.S.O. post would be created over all four divisions, the post of Head of Chemistry, Physics and Metallurgy Department. This had the great merit that the minimum interference with existing arrangements would take place. Indeed, we have, throughout our discussions regarded the present arrangements as so satisfactory that, whatever we agreed to, the minimum interference with those arrangements must happen.

As regards Mr. Carpenter's own position, I have been very conscious of the fact that a lot of his work while at R.A.E. has been directed towards the creation of a proper physics centre within the Establishment, and I have been completely in agreement with him about the desirability of doing this. I feel extremely happy, therefore, that an arrangement may come to pass in which

Mr. Carpenter ends his career as an Individual Merit D.C.S.O. in charge of precisely such a basic physics centre for the Establishment, and I think we certainly will be extremely lucky to have a physicist of his distinction heading this division. I mentioned birthdays before but, of course, it is immediately evident that, in the position that I have just described as the Head of a mainly research division, the sort of difficulty I mentioned does not arise and we hope to have Mr. Carpenter's services in this capacity for many years to come.

Now, I mentioned the concept of a D.C.S.O. post, in charge of the combined Departments and over these four divisions, and I would like now to mention one or two of the advantages we see in the creation of such a post. First, we value the incentive that might arise from the knowledge that there is a D.C.S.O. post in the scientific fields of chemistry, physics and metallurgy, and that scientists in one of these fields within the Establishment can hope to rise to the level of D.C.S.O. without necessarily having to give up their immediate association with scientific laboratories. This we regard as an advance of some importance. I have mentioned already another advantage, that it gives us the ability to retain an outstandingly good man.

Yet another, that both D.D.(A) and I have felt rather strongly about, is that a single individual could give us advice throughout the materials field. Of course, there will be difficulty during the initial stages. It is impossible to find any one individual, probably in the Kingdom, who we could bring in and say "run Chemistry, Metallurgy & Physics, you know all the subjects and can no doubt give us advice right from the start" but we felt that the right person brought in after the usual kind of time required for learning, taking advice and gaining experience in the field would, after a certain time had elapsed, certainly after, say, 12 months, begin to get a very valuably integrated view over the whole field. After all, we are faced with the trouble, very often, that the metals and non-metals are actually in competition for specific applications. This is a good example of where we would greatly value the advice of somebody whose task is to survey both sides and come to the best possible technical judgement on that kind of competitive situation.

We felt also that the Head of such a combined Department could do something to encourage this very desirable broadening of interest that I spoke of. I am not proposing here any nonsense like expecting a chemist suddenly to become a metallurgist, but I am suggesting that he can get a lot of value out of an attempt to understand the problems of the metallurgist and that what he does get out of this may help him sooner or later in his own work.

Well, I have spoken in rather absurdly general terms, up to now, about the plan as it began to take shape in our minds, but, of course, no organisation plan is of value without a discussion of individuals who are going to do the jobs and, from an early stage, it was in our mind that we did have in the Establishment one outstanding person who could do this job and run the combined Departments in the shape of Dr. Mullins. Dr. Mullins's distinction is undisputed. His work is extremely well-known in this country and abroad. Perhaps he won't be embarrassed if I go into biographical details and refer, perhaps, to 50 research papers and two books, some of which I know very well. I knew those before I came to R.A.E. because of my interest in combustion, but Dr. Mullins has done a lot of work also in the basic chemistry field, including a number of researches on new analytical processes and processes for the determination of particular compounds; he has done work on theory and experiment in the field of vapour-liquid equilibrium; finally, he is an international authority on physics and chemistry of combustion, covering, in fact, the whole range of that subject from diffusion flames on the one hand to high-intensity combustion on the other, and from, on the one hand, matters such

as emission spectra to, on the other hand, the complex details of the recirculatory flows that are involved in applications of combustion.

I have been most impressed by Dr. Mullins's impact in various areas of Chemistry Department, particularly the great interest that he has taken in synthetic work, which was new to him, and the undoubted influence that he has had on the rapid increase of the work in the synthetic field during the last two years. This, of course, is a very important consideration, because whoever we might consider for this job would have to be very energetic in learning, particularly all the subjects that find a place in Metallurgy & Physics Department. However, there seems to be a bit of surplus energy in this respect in Dr. Mullins's case; when he hasn't anything better to do he picks up a new language like Russian or Chinese. I think he may have to slow down the Chinese a bit during the coming year, while he has a go at the grain boundaries and so on!

I feel extremely glad that Dr. Mullins has shown himself willing on behalf of the R.A.E. to tackle this extremely difficult job. He has himself asked me to remind the audience of the time that it will inevitably take a Head of this new, combined Department to get a grip of the huge field involved. This, of course, is the main reason why we are proposing no reorganisation at all to accompany the change, merely the continued smooth working of the existing four divisions. I would expect, however, that, after a period which, probably, lies within the limits of 6 to 12 months, the new Head of Department, bearing in mind all the areas of common interest that I have mentioned, may suggest useful elements of reorganisation that could well lead to improved effectiveness in the long run. At the same time, I know from my contacts with Dr. Mullins that he will approach a matter like this with the utmost consultation of all the people concerned.

One final point in connection with this new post that has weighed with me to some extent was the balance within the Establishment as a whole. In the past we have had, in fact, 11 D.C.S.O. posts in the Establishment, 4 of these roughly in the aeronautical, structural and mechanical engineering fields, and 4 roughly in the electrical fields, Radio, I.A.P., Electrical Engineering, Instrumentation & Ranges, and 3 in the applications fields of Weapons and Space. I have felt that there was a lack of balance here, that bearing in mind the enormous importance of materials to the whole subject of aviation and rocketry this division was wrong, and, in fact, the more perceptive among you will realise that I have adopted a highly non-Parkinsonian solution, in which one of the D.C.S.O. posts has been taken away from the electrical area, and that post is being used to head up the sciences of materials area.

Well, I have given all the arguments, I think, that were in our minds during the rather long discussions that we have been having during most of this year on whether this was the right thing to do. During those discussions I think I have talked to all the senior people involved at R.A.E. and at Headquarters, and all concerned have agreed that this is the right policy. Above all, the Chief Scientist has especially given his blessing to the development that I have described. In fact, the Chief Scientist himself attaches particular importance to the pursuit of 'applied high-grade science' with major application in the materials field. There are parallel developments elsewhere; for example, he has caused the materials team at E.R.D.E. Waltham Abbey, to expand. His plan is that, although we have more than one materials group in the Ministry of Aviation, we do not have hard and fast rules about spheres of application. Thus, the materials people at R.A.E. may work on problems that have applications outside the immediate matters of the airframe, and if you were to have a good line and which seemed to have very important applications to engines or rockets or any other field in which the Ministry is interested, it is planned that there should be no obstacle to R.A.E. working in such a field. In other words, there is multiple utilisation of these different groups.

I have agreed, in particular, with the Director of N.G.T.E., Mr. Weir, that we can gain a lot by collaborating. He has, of course, a Chemical Physics Department and a Metallurgy Department. We decided to begin by a big colloquium, at which both sides expound all the problems that they are facing in the materials field, and expound the kind of new processes that they are working on, and try to see how far these related and how far either side is able to help the other. At the same time, Dr. Mullins is already working with the Director of E.R.D.E., Waltham Abbey, to promote good exchange of information with his materials group. There are an awful lot of ideas floating about in this field. No doubt, a lot of them are quite insufficiently worked out, and a lot of them are not worth following up. On the other hand, there are so many that I think it is important to try to get sorted out which are the ones that can valuably be followed up and are ultimately promising.

I would like to see Chemistry, Physics & Metallurgy Department spreading its influence very widely indeed in this respect and acting, as I said, rather as a centre for a lot of the research work that is going on in the country. We might be able to convert the better University teams to taking rather more seriously the requirements in applications to advanced technology. We can probably do a lot for the industrial teams. I am particularly keen that we should not in every case stop short when it comes to thinking about large-scale processes. I am glad to note for example Mr. Bickerdike's developments, where he has been tending to go on from laboratory scale researches to think about large-scale processes, and I think we should always consider how far this may be possible. There will be many cases where it is not possible in the R.A.E. It is no good trying to do something you can't do. But, if new processes are developed on the laboratory scale, I think one must always have at the back of one's mind "What is my plan for seeing how this could be converted into a large-scale process? Am I thinking of taking some industrial team into my confidence and trying to get them giving thought to this? Should I seek to put out a Contract at some stage?" This is the sort of consideration that I am sure must be constantly in our minds.

Well, I have very little more to say. I would emphasize that all of us here on the platform* and all those with whom I have discussed this matter both at R.A.E. and at Headquarters, are in agreement that this is the right plan, and, in fact, the Chemistry, Physics and Metallurgy Department will be set up as from the 19th November, and I would like to conclude simply by saying that I do hope that everyone in this Hall will give their full co-operation to us in this respect. This is something that we have given extremely careful and extensive thought and discussion to, and we are completely sincere in recommending to you that this is the right solution for these two Departments, and I will say again that I have been very satisfied with what these Departments have done in the past, but I hope that this measure will do something to enable them to do even better in the future.

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* The platform party consisted of, Dr. Lighthill, Mr. Handel Davies, Mr. Twinn, Mr. Carpenter and Dr. Mullins.

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DCA(RD)
DCA(RAF)
DCA(RN)
DCW
DCL
DGAGS
DGSR(A)
DGQ
DGGW
DGBM
D Mat.
DA Mech.
D Struct.
AD Elec.
AD Mat.(M)
AD Mat.(NM)
ADMX RD

D/RRE
D/NGTE
D/RPE
D/ERDE
D/SRDE
CS/A & AEE

SPSO's and equivalent or higher ranks in R.A.E.

PSO's and equivalent ranks in the former Chemistry and Metallurgy & Physics Departments, R.A.E.

RAE Whitley Council and Joint Factory Committee.

Pats 1 R.A.E.

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Date of Search: 9 December 2008

Record Summary: AVIA 6/17609
Title: Formation of Chemistry, Physics and Metallurgy Department
Availability Open Document, Open Description, Normal Closure before FOI Act: 30 years
Former reference (Department) TECH MEMO DIR 15
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